

# A Comprehensive CFD Tool for Aerothermal Environment Around Space Vehicles, Phase I

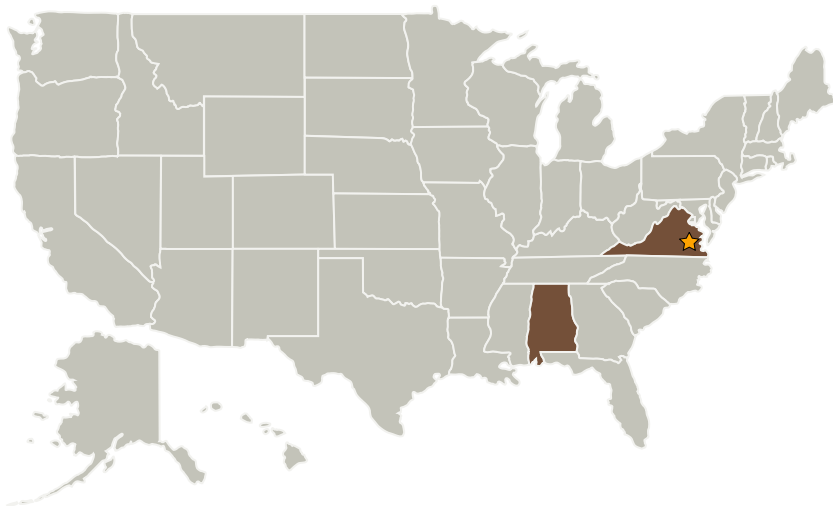
Completed Technology Project (2009 - 2009)



## Project Introduction

The goal of this SBIR project is to develop an innovative, high fidelity computational tool for accurate prediction of aerothermal environment around space vehicles. This tool will be based on the Unified Flow Solver (UFS) developed at CFDRC for hybrid simulations of rarefied, transitional and continuum flows. In this project, UFS will be enhanced to include: Boltzmann/continuum solvers for vibrationally excited molecules, advanced non-equilibrium chemistry coupled to non-gray radiative transport with real gas effects, and charged particle transport and chemistry. The unique strengths of our proposal are: (i) smart software with self-aware physics and adaptive numerics for hypersonic flows with non-equilibrium chemistry, (ii) direct Boltzmann solvers for charged and neutral particles in rarefied regimes, and (iii) a high-fidelity multi-scale radiation transport model that can handle orders of magnitude variation in the medium optical thickness. Phase 1 will include evaluation of physical models, initial implementation and demonstration of new capabilities. In Phase 2, these capabilities will be fully developed, validated for selected benchmark problems, and applied to practical cases relevant to NASA. The proposed tool will significantly upgrade the modeling fidelity of high-speed flows of molecular gases, and enable computational investigation of innovative hypersonic flow and plasma technologies.

## Primary U.S. Work Locations and Key Partners



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## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission  
Directorate (STMD)

### Lead Center / Facility:

Langley Research Center (LaRC)

### Responsible Program:

Small Business Innovation  
Research/Small Business Tech  
Transfer

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Organizations Performing Work	Role	Type	Location
★ Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia
CFD Research Corporation	Supporting Organization	Industry	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Virginia

## Project Management

### Program Director:

Jason L Kessler

### Program Manager:

Carlos Torrez

## Technology Areas

### Primary:

- TX15 Flight Vehicle Systems
  - └ TX15.1 Aerosciences
    - └ TX15.1.2 Aerothermodynamics